R E P O P T R E S U M E S

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SPEECH INACCURACY IN CHILDREN AS RELATED TO ETIOLOGY.

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THE AIM OF THIS RESEARCH PROJECT WAS TO IDENTIFY THE ARTICULATORY INACCURACY PROFILES OF CHILDREN ACCORDING TO THE ETIOLOGY OF THE CONDITION PRODUCING THE SPEECH DIFFICULTY. DURING THE FIRST PHASE OF THE RESEARCH, A BATTERY OF TESTS TO PROVIDE INFORMATION ON THE ARTICULATORY PATTERNS, VERBAL INTELLIGENCE, AND AUDITORY PERCEPTION OF NORMAL CHILDREN WAS PREPARED AND TESTED. THE SECOND PHASE OF THE RESEARCH WAS DEVOTED TO A STUDY OF THE ARTICULATORY ERRORS OF THREE EXPERIMENTAL GROUPS OF CHILDREN WITH SPEECH PROBLEMS STEMMING FROM DEVELOPMENTAL LAGS, FROM MENTAL RETARDATION, AND FROM AN OPERATED CLEFT PALATE OR CONGENITALLY SHORT PALATE. THE DATA COLLECTED FROM BOTH PHASES OF THE STUDY REVEALED THAT THE ARTICULATORY PROFILES DERIVED FOR CHILDREN WITH DIFFERENT ETIOLOGIES ARE EACH DIFFERENT FROM THE OTHER AND READILY IDENTIFIABLE AS THE PROFILE CHARACTERISTIC OF THE ETIOLOGY OF THE DISORDER. THE GROUP CONSIDERED AS SUFFERING FROM DEVELOPMENTAL LAGS WAS FOUND TO HAVE ARTICULATORY ERROR PROFILES IDENTICAL WITH THE NORMAL POPULATION AND THEREFORE SHOULD BE CONSIDERED AS PART OF THAT GROUP. (WB)

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Preface

The research reported herein relating to the articulatory ability of children in the early school years is part of a continuing program of research into the development of cognitive and communicative processes in children. The Speech and Language Clinic at the University of Chicago is a part of the medical school complex. It is staffed both for its clinical teaching and research activities by the Department of Psychology, the Committee on Human Development and the School of Graduate Education under the immediate auspices of the Interdepartmental Committee on Clinical and Counseling Psychology.

The specific research here reported was under the direction of Joseph M. Wepman, Ph.D., Professor of Surgery and Psychology, Director of the Speech and Language Clinic and Research Projects, and Chairman of the Interdepartmental Committee on Clinical and Counseling Psychology. The Project Director was Mrs. Anne Morency, M.A., Assistant to the Director of the Speech and Language Clinic, assisted by Paul Weiner, Ph.D., Associate Director of the Speech and Language Clinic. During the course of the research program the following students served as research assistants: Roberta Pikser, (College); Mildred Schaefer (Human Development); Jack Vognsen (Psychology); Linda Rothstein (Humanities); Robert Jenkins (Psychology); Gerald Coates (Education); Bernard Frieden (Education); Eileen Trafimow (Psychology); and Neal Warren (Psychology).

The Brookfield, Illinois, Public School System cooperated throughout in the collection of data. Especially Mr. T. Kawalek, Superintendant; Miss Judy Nelson, Speech Pathologist and Miss E. Huff, School Nurse. Also of great assistance in providing clinical case material

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was the Special Education Branch of the City of Chicago Public Schools through the cooperation of Dr. Margaret Hall Powers, director, Bureau of Physically Handicapped Children and Miss Carol Crotty, supervisor, Division of Speech Correction, Northwestern University Cleft Palate Clinic, Dr. Richard M. Cole of the Henner Memorial Speech Clinic of Michael Reese Hospital, Mr. Thomas Buran, School Psychologist of Hammond, Indiana, Public Schools, and Miss Linda Hurowitz, of the Child Guidance Clinic, Children's Memorial Hospital, Chicago, Illinois. Drs. Lyle V. Jones, Director of the Psychometric Laboratory, the University of North Carolina, and Henry Hollien, Director of the Voice Science Laboratory, the University of Florida, served as Consultants to the project.

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I BACKGROUND AND OBJECTIVES

The present research was undertaken within the context of children as they enter formal education in the public schools. The tendency for so many of these children in kindergarten and the early elementary grades to speak and to read orally with inaccuracies in their pronunciation has been a matter of much concern to teachers and parents alike. The extent of the problem of speech inaccuracy has been noted in a variety of survey studies. Reid (1947) reviewed a number of these and concluded that a 'reasonable estimate' of the percentage of children involved would be as high as 27% in kindergarten, 19% in the first grade, 11% in the second grade and 9% in the third grade. The seriousness of the problem aside from the actual number of children involved lay in the consideration so often given that these children suffer from a' speech defect'. This opinion is widespread despite very good evidence that the normal acquisition of speech sounds continues progressively and in a somewhat predictable and orderly manner through the seventh year of life. (McCarthy, 1930; Poole, 1934; Templin, 1957). Little or no attempt has been made in the schools or clinically, to separate children whose speech inaccuracies were due to some pathological factor from those who speak inaccurately due to simple delayed maturation of the prerequisite perceptions and motoric development upon which accurate enunciation is based.

Underlying the research as well was the extensive clinical experience of the principal investigator and the staff of the University of Chicago Speech and Language Clinic. Here, it was noted that of the literally hundreds of children referred for 'speech defects' over the years, less than one in four demonstrated a pathological entity such as cleft palate, mental retardation, deafness or emotional immaturity to

account for their speech inaccuracy. Studies made of many of these children, and later of many others (Wepman, 1960) showed a tendency for inadequate auditory perception to be common among them. This led to the clinical recognition that even in a medical speech and language clinic where admittedly there is a selection of the more serious speech problems as compared to the general population in the public schools, the etiology of the majority of the articulatory problems seen may be developmental in nature, rather than pathological.

Parenthetically, as the data for the present research became available for study, other developmental factors than auditory imperception; especially delays in development of motoric coordination, could be seen as accounting for certain articulatory inaccuracies. This additional factor will be discussed in a later section as the results of our studies make more explicit the relationship between lags indevelopment and articulatory inaccuracy.

Within this general framework, then, the research was undertaken. First, to identify the articulatory inaccuracy patterns or profiles of children with different etiological backgrounds. Second, to demonstrate the existence of a group of otherwise normal children who during their early school years showed articulatory inaccuracies due to developmental rather than pathological reasons.

The importance of the latter factor, the developmental etiology of articulation deviations, was seen as vital both to the child and to the school systems. The child, because he would not then be considered as 'defective' with all that such labelling involves, and the schools because they would neither need to provide therapy for such children, nor consider them as defective. They could recognize the essential normal-

cy of a considerable portion of their population which had previously been of great concern to them as potentially subnormal problem children.

Through the research design, other objectives were subjected to study. A problem of much concern to some teachers and to many parents is the relationship between poor articulation and intellectual ability. While little data bearing on this important consideration was available it was clinically evident that as often as not children between the ages of five and nine who were referred to the Clinic because of their articulation problems were thought to be to some degree mentally retarded. Some school systems in fact were known to retard the progression of children due to this speech factor alone. It was also often apparent in the attitudes expressed by parents of such children that they considered and treated their children as if they were less than normally intelligent. The parents' fears and anxieties for their children reinforced by the attitude of the childrens' teachers created an atmosphere and a climate endangering the normal development of the children. The present research was planned to provide evidence on this relationship between articulation and intelligence. It was hypothesized at the onset that children with specific lags in development of articulatory accuracy due to maturational rather than pathological etiologies would show no significant relationship between their measurable intelligence and their speech inadequacy. Further, by including within the study data on children with known mental retardation it was reasoned that different and more extensive profiles of speech inaccuracy would be demonstrable.

The final objective developed from the research design itself. Over the years the principal investigator has been concerned with the

differential ability of children to learn along the major input pathways or modalities. This modality concept of learning which has been reported in greater detail elsewhere (Wepman and Jones, 1960) and is still the object of considerable research, holds that due probably to both genetic and environmental conditioning, children differ in their capacities to utilize their auditory, visual and kinesthetic pathways in learning. Charcot (Freud, 1953) first discussed the concept of the 'audile', 'visile' and 'tactile' child. (Fortunately, very few children are thought to be truly tactile, but almost all children can be considered within the dichotomy of visual and auditory abilities.) The audile child, it is held, would be the early and more accurate speaker, the visile child the later and less accurate speaker. This concept has many far reaching and important tangents for educators and psychologists interested in development. For the present research it meant that to gain a full understanding of the articulatory inaccuracies of children it would be necessary to gauge their ability to articulate both by visual and auditory means. This necessitated the development of a dual modality test for articulation as the first objective of the research planned.

To recapitulate, the study was conceived against the background of the child entering his educational career. It was designed to isolate and depict the articulatory profiles or patterns of children with differing etiologies, pathological and maturational; to show some of the relationships between measurable intelligence and speech adequacy; and, to define the speech profiles through a dual modality test for articulation.

II RELATED RESEARCH

The literature relevant to articulatory problems in childhood is extensive, but for the most part not closely related to the very specific interests of the present research. For example, most texts on speech pathology such as Van Riper (1954), West, Ansberry, and Carr (1957), and Travis (1957) allude to the idea and even to some of the specific sounds that are found in certain pathological conditions without attempting to establish a total profile of articulatory error for any condition. Mullendore (1961) and Byrne (1961) in their research reports similarly point out characteristic errors of certain syndromes. Counihan (1960) explored the explicit errors made by cleft palate children, while Irwin (1961) spelled out quite carefully the articulatory problem of the child with cerebral palsy. In both of the latter instances, the populations discussed were of much younger age groups than those of the present research. Spriesterbach, Darley, and Rouse (1956) made the most related evaluation of the articulatory errors of children with cleft lips and palates. In this single instance the population studied included children in the same age group as the present study.

There appears, however, to be no specific research related to the group of children of major concern to the present study, those whose articulatory inaccuracy cannot be ascribed to pathology, but rather appears to be the product of delayed development of the prerequisite perceptual (and motor) abilities for accurate speech production. The work of Roe and Milisen (1942) did indicate the significant differences in the number of children in grades 1,2, and 3 who made errors in articulation. They interpreted their results as an indication that growth and maturation serves to eliminate many sound errors. Van Hattum

(1959) pointed to the need for a selective system that would predict errors that will be eliminated through maturation alone and those due to pathology and thus necessitating continual therapy. He pointed to the fact that speech therapists were often without foundation in their attempts to exclude children below the third grade from therapy programs. On this same point of selection of the population needing therapy, Steer and Drexler (1960) commented following their study in the prediction of later articulatory ability from tests given to kindergarten children, that the basis for selecting a case load for the speech therapist has not been clearly established. They went on to posit that if it were possible to identify in kindergarten or first grade those children who would not achieve good articulation through the normal process of maturation, the problem of case selection would be greatly simplified. It is to this very point that the present research directs itself, the isolation of the child with developmental inaccuracy of speech production who should be the child whose speech will become accurate as he matures.

Over many years, numerous studies of the development of normal speech have contributed to the concept of spoken language accuracy as a maturational process -- the now classical studies of McCarthy (1930, 1946) the frequently quoted work of Poole (1934) and most recently the monumental studies of Templin (1957). In this latter work, Templin shows the progressive and somewhat orderly manner in which speech sounds are acquired. She makes the telling point from her data that by comparing a child's proficiency in consonant production with developmental norms as the measure of expectancy (rather than assuming that every mispronounciation is an indication of a speech defect) it is possible to make a most logical determination of the need for therapy. Templin's (1957) studies of the acquisition of speech sounds are felt

to be so important to this field and to the present study that in a later section a comparison of the data found on the standardization (normal) population and Templin's data on her normal population will be made.

Few studies have utilized the dual modality concept of articulatory testing suggested for use in the present study; yet as long ago as 1954 Snow and Milisen commented on the prognostic value of such an approach. Similarly, little has been said in a research way concerning the relationship between intellectual ability and articulation. Prins (1961) noted a relationship between "those (children) committing errors of omission...have lower I.Q.'s"; he made no generalizing comments, however, on the over-all relationship. The present study as has been indicated, considers this parameter a major part of the study by studying the specific profiles of children considered to be mentally retarded and relating them to children known to be adequate in intelligence.

III METHODOLOGY AND RESEARCH DESIGN

The research was planned in two stages. The first to consist of the designing and construction of a dual modality test of articulation and the standardization of the new test on a stratified sample of children between the ages of 5 and 9. The collection of standardization data on the test, it was felt, would also provide a normal sample against which the different experimental groups could be compared. The second stage, the experimental phase, was designed to collect data on the speech of three selected groups of children, all between the ages of 5 to 9, with different etiologies. Experimental Group 1, Developmental; Experimental Group 2, Mentally Retarded; Experimental Group 3, Cleft or short palate.

A. A test battery was designed to provide data on (1) the speech error (Dual Modality Test of Articulation), (2) verbal intelligence (Peabody Picture Vocabulary Test), and (3) auditory perception (Wepman Auditory Discrimination Test).

To minimize socio-economic factors which it was felt might play a role in any difference found between the normal control group and the developmental experimental group, all of the children in these two samples were tested in the same school system, the Brookfield, Illinois Public School System*. Brookfield, Illinois is a middle income, middle class suburban community. The children were all to be American-born and all to speak English as their native tongue.

1. Design and construction of the Dual Modality Test of Articuation

The test was designed in two parts - a visual form and a roughly equated auditory form. Only initial consonants were tested. The observations of such researchers as Wellman(1931), Poole (1934), Sheridan (1945), West (1947), Metraux (1950) and Templin (1957) were consistent in their findings that initial sounds appear in the speech of children before medial and final sounds. The articulation of vowel sounds were not tested. According to these same researchers, it is evident that vowels appear in the speech of most children pronounced with comparative accuracy well before the age level of the present research. Further, the data sought, construction of articulatory profiles, it was felt required only a screening type of examination to test the articulation accuracy of the children rather than a detailed description of their speech efforts.

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* The Brookfield School System's Superintendent, Mr. T. Kawalek, its speech therapist, Miss Judy Nelson, and its school nurse, Miss E. Huff, were most cooperative in providing the research with the normal and developmental populations, and in assisting in the research testing.

Since what was sought was a profile of articulation accuracy or inaccuracy related especially to the definition of the heretofore unspecified group, the children with maturational or developmental lags in speech sound acquisition, the order of presentation of the sounds was studied at some length. The progressive acquisition of sound accuracy has been most thoroughly studied most recently by Templin (1957). While her data indicates that no sharply defined age for the acquisition of each sound can be determined, the sounds do come into use in a relatively regular and prescribed order. Table 1. shows this order and the words selected to illustrate each of the sounds.

Table 1.

Words used on the Dual Modality Articulation Test

		VISUAL MODALITY				AUDITORY MODALITY			
No.	SOUND	STIMULUS	RESP.	STIMULUS	RESP.	STIMULUS	RESP.	STIMULUS	RESP.
1	t	t.v.		table		time		took	
2	d	door		dog		day		done	
3	n	knife		nose		need		new	
4	m	moon		monkey		my		most	
5	b	baby		bed		big		but	
6	h	house		hammer		how		him	
7	w	wagon		window		wait		wish	
8	p	pencil		pig		pay		pass	
9	k	car		cat		cut		call	
10	f	fork		foot		for		fine	
11	g	gun		gas		good		get	
12	y	yo-yo		yard		yet		you	
13	l	leaf		lamp		low		look	
14	sh	shoe		shadow		should		show	
15	th'	----		----		that		them	
16	v	vacuum		vegetable		very		visit	
17	s	sun		scissors		same		seem	
18	z	zipper		zebra		zinc		zone	
19	j	giraffe		jump		just		job	
20	r	radio		rain		ride		race	
21	ch	chain		chair		chase		choose	
22	th	thumb		three		think		thank	

The sound th (voiced) is omitted from the visual presentation since no picture could be found which elicited the sound.

The sound wh was eliminated from both visual and auditory forms since in pilot testing almost no child pronounced the sound correctly.

a. Visual form:

As Table 1. indicates, pictures were selected which when named would illustrate in the initial position of the word used, the sound being studied. Subject matter for each picture was determined after a series of pilot studies using pictures from many sources. A picture was included if on the pilot study ten unselected 5 year old children responded to the picture with the word expected. Two such picture subjects were selected for each sound. Original line drawings were then made of each picture. These were duplicated photographically and bound in acetate sheets. The final product was a collection of forty-two pictures each in its acetate cover illustrating twenty-one initial consonants. (For a detailed description of the test construction, read Morency, Anne, The Construction of a Dual Modality Test for Articulation, Unpublished Masters Thesis, the University of Chicago, 1962.)

b. Auditory form:

Words were selected for this form which when repeated after the examiner, would illustrate all of the initial consonants of English. The actual words used (see Table 1.) were determined by a) likelihood of their familiarity to the age groups being tested, juvenile word lists, the Thorndike-Lorge Word Counts (1944) and a survey of phonic word books. Pilot tests on each word selected indicated that each of the two words used to illustrate a particular sound were equally well known to children in the age range (5 to 9) being studied; b) only words which did not lend themselves to a visual image were used to obviate the repetition of a word from the association to that modality rather than to the auditory modality. Forty-four such words were selected and used in the test.

2. Standardization

a. Population

Forty children, equally divided between the sexes, at each age level between the ages of 5 and 9 were tested. The following criteria were used in the selection of the normal population:

(1) Normal intelligence Mental age as determined by the Peabody Picture Vocabulary Test (Dunn, 1959) within at least one year of their chronological age. (The Peabody Picture Vocabulary Test was used as an estimate of intelligence for two reasons. First, for the control group, assurance was needed that verbal intelligence was at least adequate since we were concerned with speech production and wanted to obviate the possibility that within the normal population children with language delay did not appear. Second, the test used is according to its standardization data, highly correlated with general intelligence ($r = .84$.) (Dunn, 1959)

(2) Adequate auditory and visual acuity as determined by school screening tests for audition and vision.

(3) Adequate speech according to the criteria established by the speech therapist in the school system who had screened each child and considered them free of any speech problem.

b. Test Administration

Each child was administered the battery consisting of the articulation test, vocabulary scale and auditory discrimination test.

c. Analysis of Data

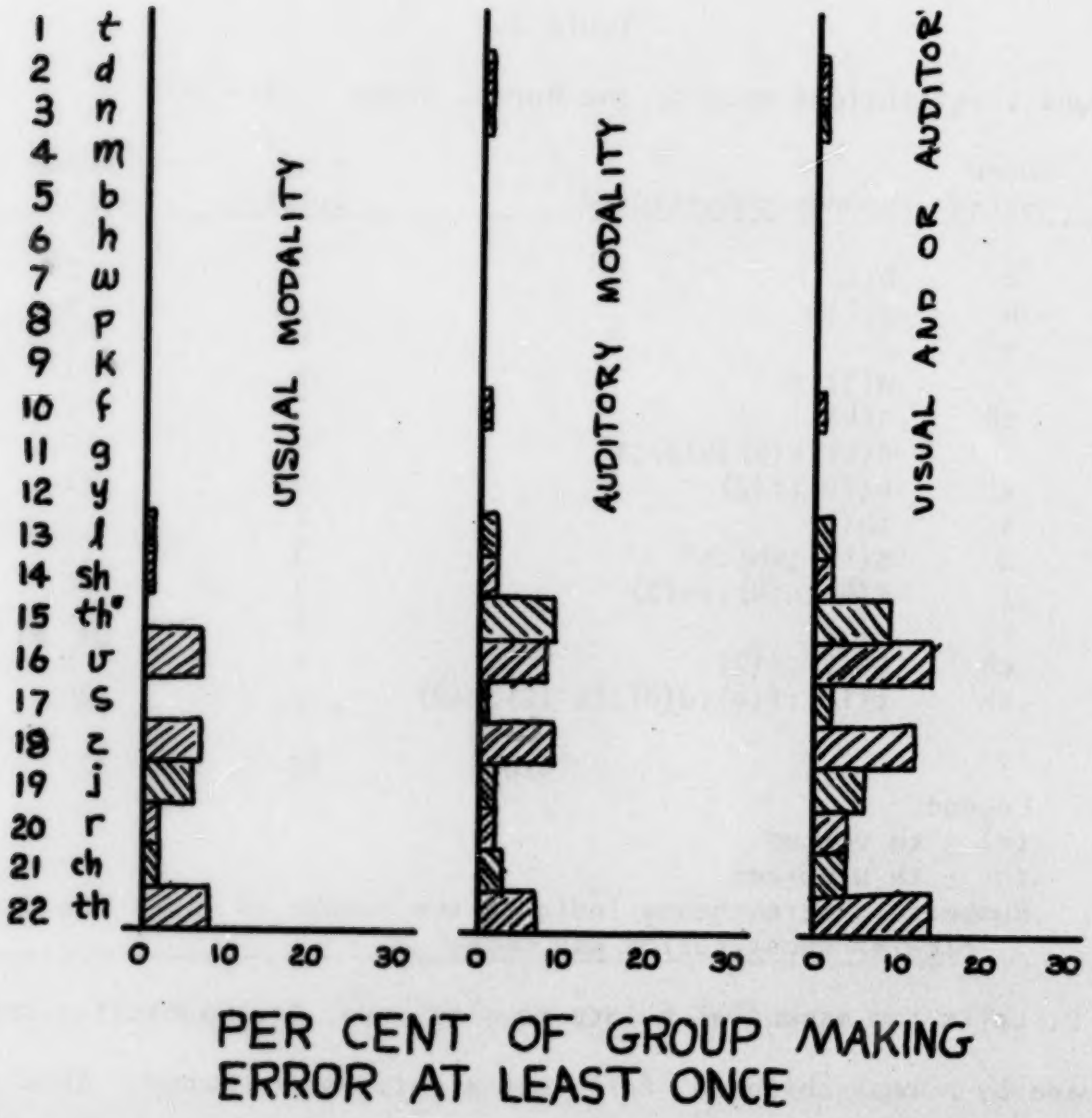
The following graphs and tables present the articulatory error profiles of (1) the total normal population by percentage of errors and by the actual substitutions made, (2) each age group separately

with errors noted to either visual or auditory presentation combined, (3) errors made to the visual form of the test, (4) errors made to the auditory form of the test, and (5) a comparison of errors made by boys and by girls.

(1) Percentage of group making errors, visual, auditory and combined.

Diagram 1.

Articulatory Error Profiles for Normal Population (N = 160)



The data from the total N of 160 children show in profile form the percent of children making articulatory errors. It should be recalled that this group was screened for speech problems by the school speech therapist and were considered as not showing a recognizeable or a demonstrable speech problem. The profiles are interesting in one particular regard. Almost

all of the errors made fall in the category of sounds which are acquired last by most children (Templin, 1957). No significant difference occurs between the visual and auditory presentation although there is a trend toward greater error in the direction of the auditory repetitions. The over-all error is notably small as would be expected.

(2) Qualitative Profile

Table 2. shows the actual substitutions made by the children in the normal group.

Table 2.

Sound Substitutions Made by the Normal Group (N = 160)

Sound order	Sound tested	Sounds substituted	# of Substit.	# times Substit.
2	d	b;t	2	2
3	n	y;l;m	3	3
12	y	r	1	1
13	l	w(3);r	2	4
14	sh	s(4)	1	4
15	th'	d(6);v(5);b(3);th	4	15
16	v	b(20);f(2)	2	22
17	s	th(9)	1	9
18	z	s(10);zh;th'	3	12
19	j	d(4);g(4);ch(2)	3	10
20	r	w(5)	1	5
21	ch	sh(7);s(2)	2	9
22	th	t(10);f(8);d(4);th'(2);s(2)	5	26
		Totals	30	122

Legend:
th' = th voiced
th = th unvoiced
Numbers in parentheses indicate the number of times the particular substitution was made.

Table 2. calls two essential points to mind; one, that substitutions when made by normal children, fall into a very narrow range. Thus the ratio of different errors to children is 30:160 while the number of total errors made is less than one per child (122:160). The second detail is the very typical nature of the substitution pattern. For each of the sounds in which errors are made, a typical substitute or two appear as the most likely choice. For the last ten sounds on the scale, then, the

first or first two substitutions might well be considered a normal substitution pattern, or stated otherwise, if one of these sounds is to be misarticulated, the prediction of the substitute sound to be used can be stated with high reliability.

(3) Percent of error profiles by age.

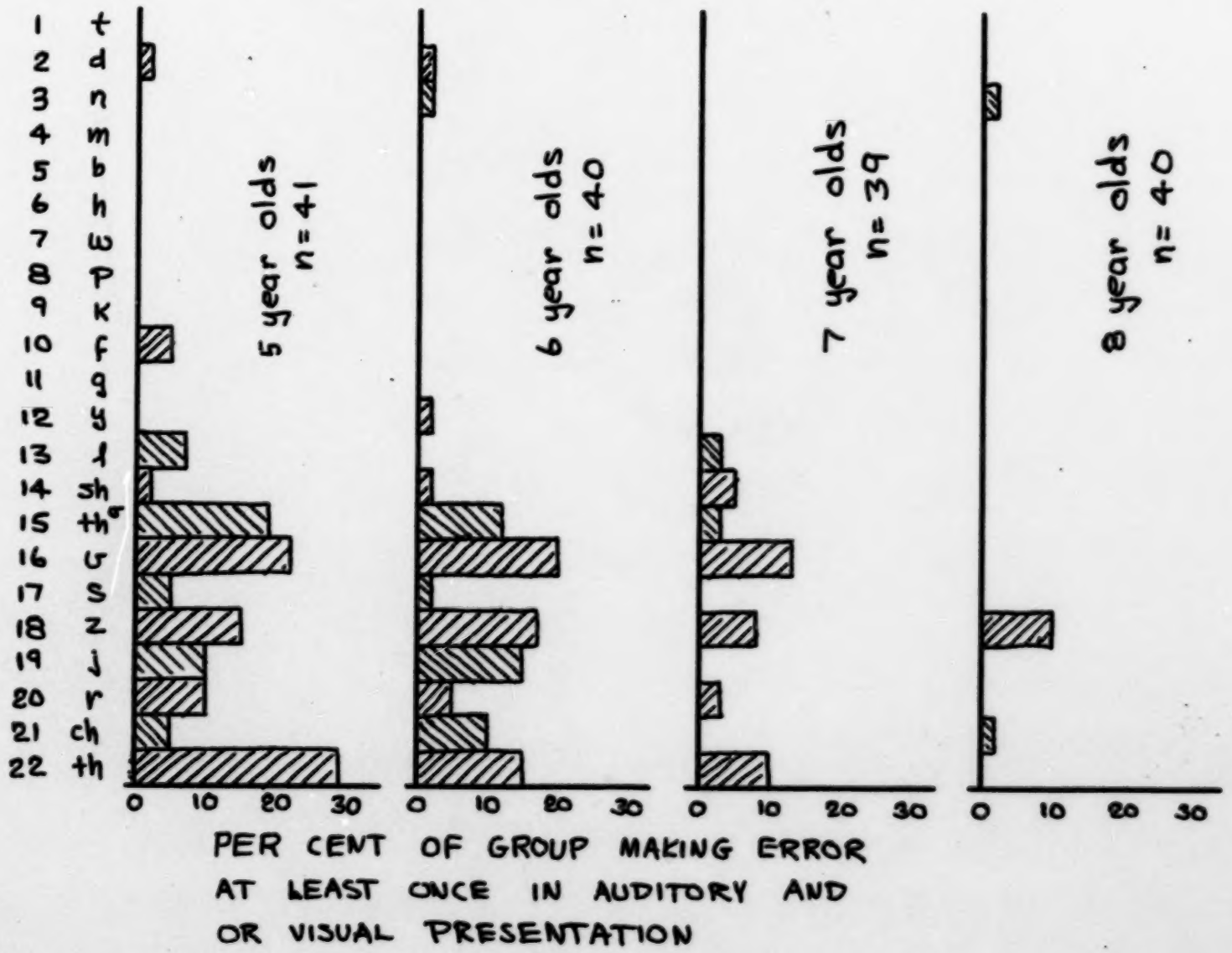
As can be seen by inspection, when the age groups are shown separately, the trend toward extinction of the articulatory errors is marked as age increases.

(4) Errors made on visual form of D.M.T.A.

The visual form of the test produced errors in articulation greatest in five year olds but not significantly different from the six year olds. The seven year old group showed a marked decline in errors made, while the eight year olds showed almost no errors.

Diagram 2.

Articulatory Error Profiles of Normal Population in Age Groups

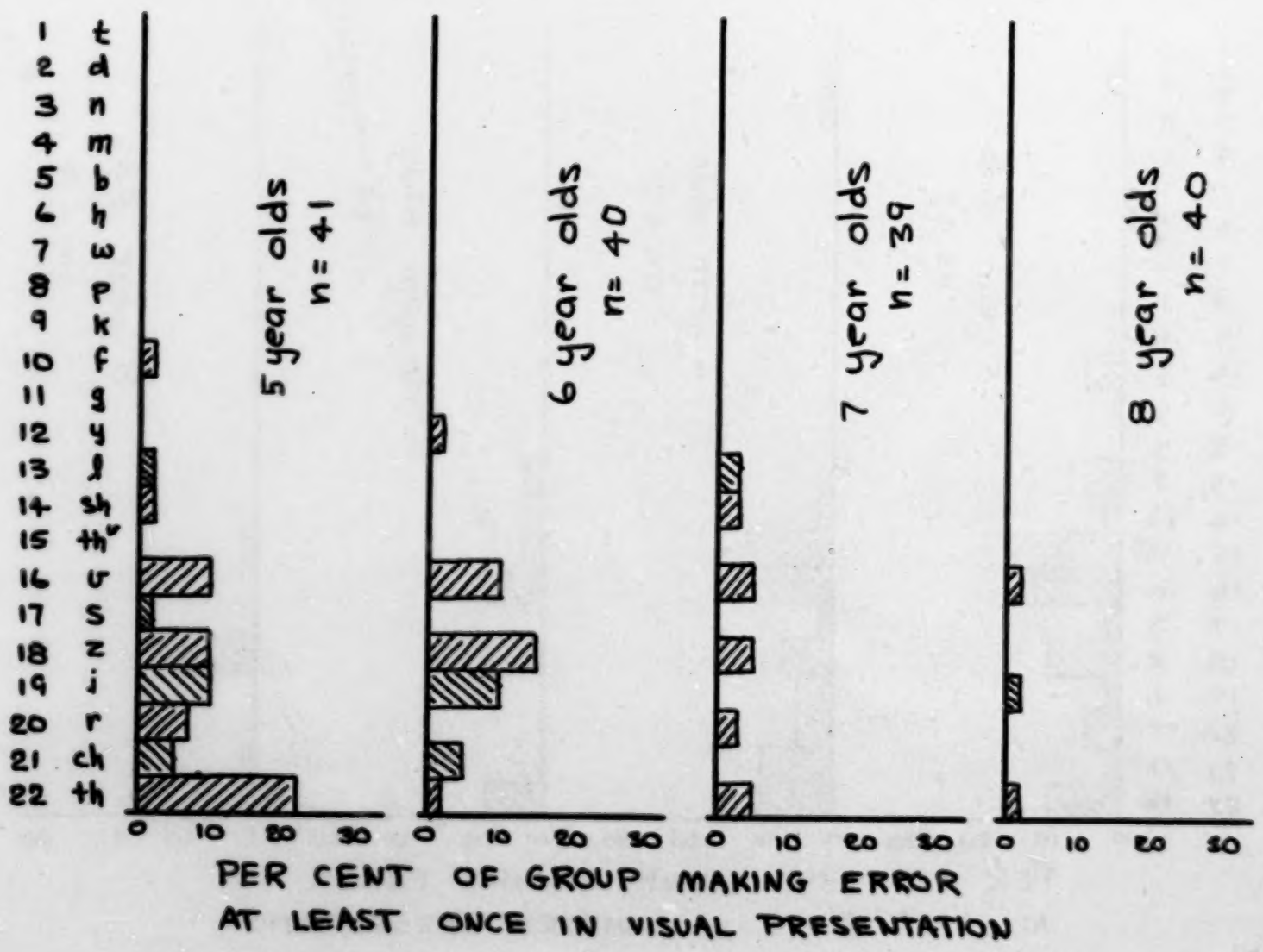


(5) Errors made to auditory form of D.M.T.A.

The response to the auditory form showed a similar close relationship between the five and six year olds with the seven year olds showing few errors and the eight year olds even less.

Diagram 3.

Articulatory Error Profiles Derived from Visual Stimuli by Normal Children in Age Groupings

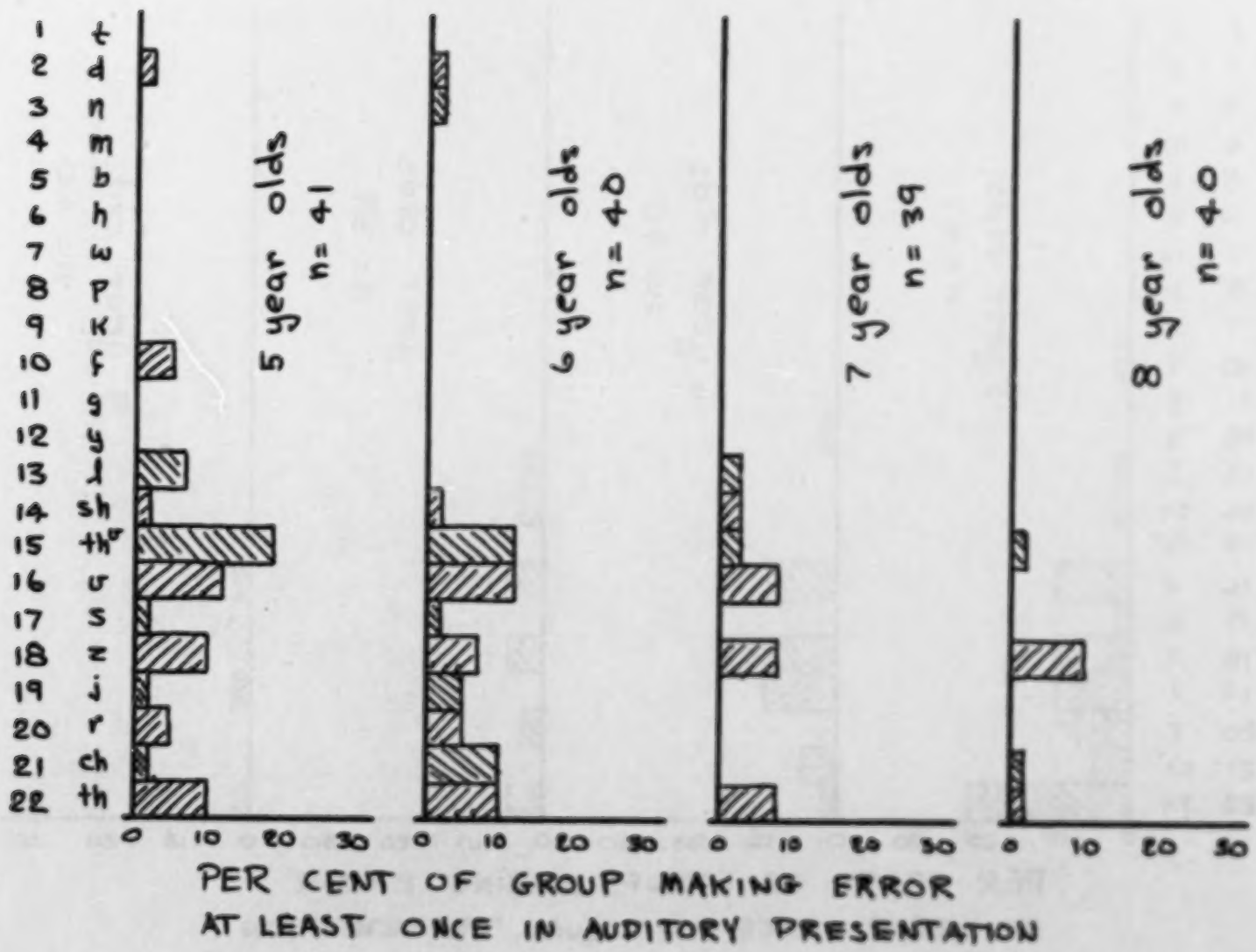


(6) Error scores of boys vs. girls

When sex difference was studied, as Diagram 5. shows, the profile of errors were relatively the same. No significant difference was shown between the two groups statistically. This is an interesting finding in the light of the common belief that boys in general show more speech errors than do girls at the ages studied.

Diagram 4.

Articulatory Error Profiles Derived from Auditory Stimuli by Normal Children in Age Groupings



(7) Comparison between forms of the D.M.T.A.

Tetrachoric correlations were run between the errors made on the two modality forms of the D.M.T.A. to test the validity of combining them into a single four-part test of articulation with the results as seen in Table 3., below.

Table 3.

Tetrachoric Correlations Between Two Forms of the D.M.T.A.

	AUDITORY CYCLE					VISUAL CYCLE			
AGE: / SOUND:	5	6	7	8		5	6	7	8
p									
b									
m									
h									
w									
t									
d		.83					.91		
n		.91		.83					
k									
g						.91	.91		.91
y						.91	.95		.91
f	.91					.91			
sh	.91	.91	.91			.91	.91	.91	
v	.71	.65	.83			.91	.96	.95	.91
th'	.33	.76	.91	.91		-	-	-	-
l	.77	.91	.91			.91		.91	
s	.91	.83				.91			
ch	.91	.83		.91		.91	.91		
z	.83	.83	.83	.71		.68	.60	.83	
j	.91	.83				.76	.69	.91	.91
th	.77	.83	.83	.91		.27	.91	.83	.91
r	.95	.91	.91			.71		.91	

(When no correlation figure is shown, no error was made.)

As Table 3. shows, there is generally such a high correlation between the two forms of the test that for the purposes of the present research they can be considered equal. The dual modality feature was maintained, however, to provide specific information on those children who showed greater proclivity on one modality over the other, and to study the dual modality concept on the experimental groups.

d. Comparison with Templin's Data

As commented on earlier, Templin's (1957) data was used as the basis both for the ordering of presentation and the construction of the articulatory profiles. Diagrams 6. and 7. below present a comparison of her data with that of the present study. Diagram 6. shows an adaptation of Templin's data to the articulatory profile method of presentation.

Diagram 5.

Comparison of Articulatory Error Profiles
Made by Boys and Girls in Normal Group

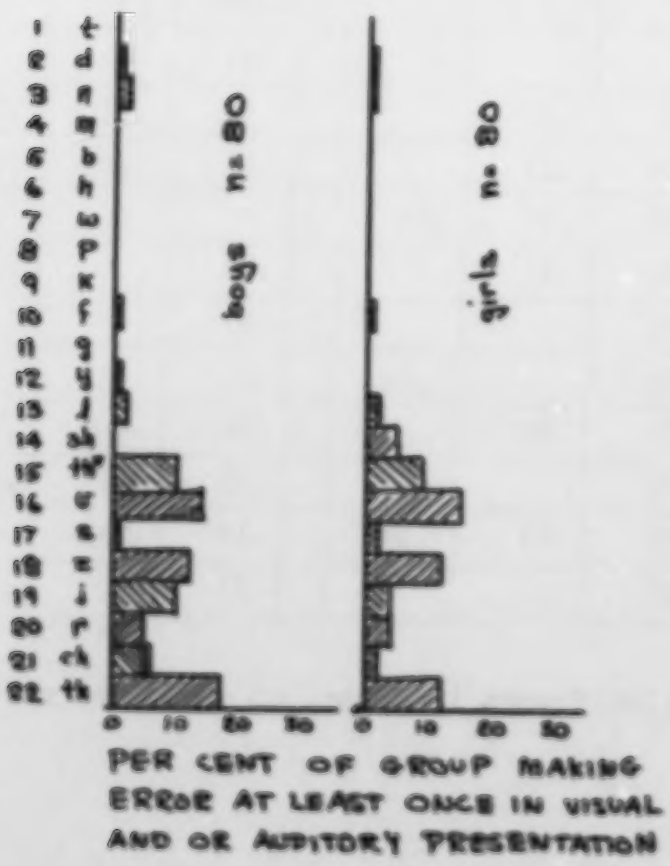
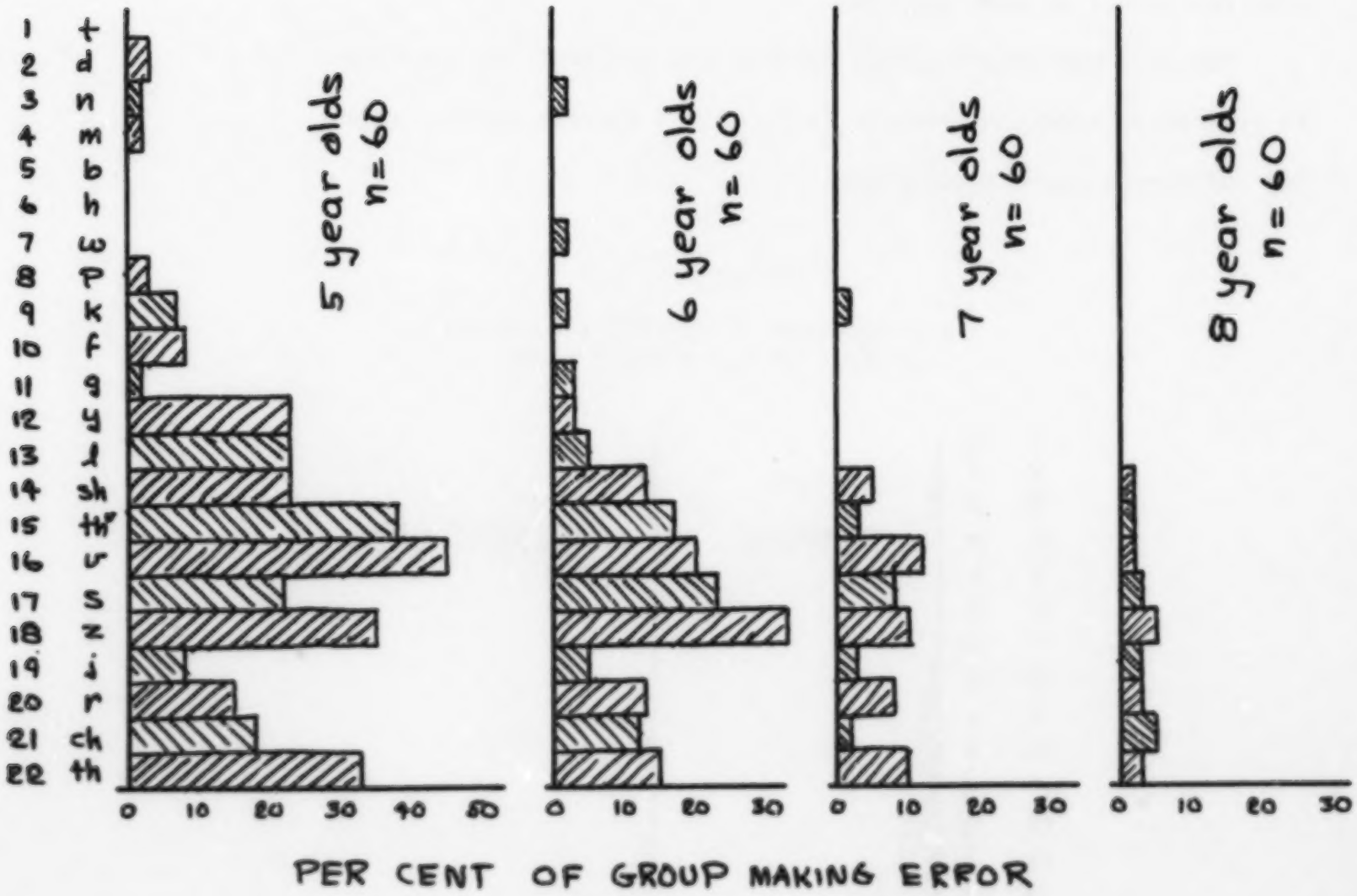


Diagram 6.

Articulatory Error Profiles Adapted for
Templin's Normals (N = 60, 60, 60, 60)



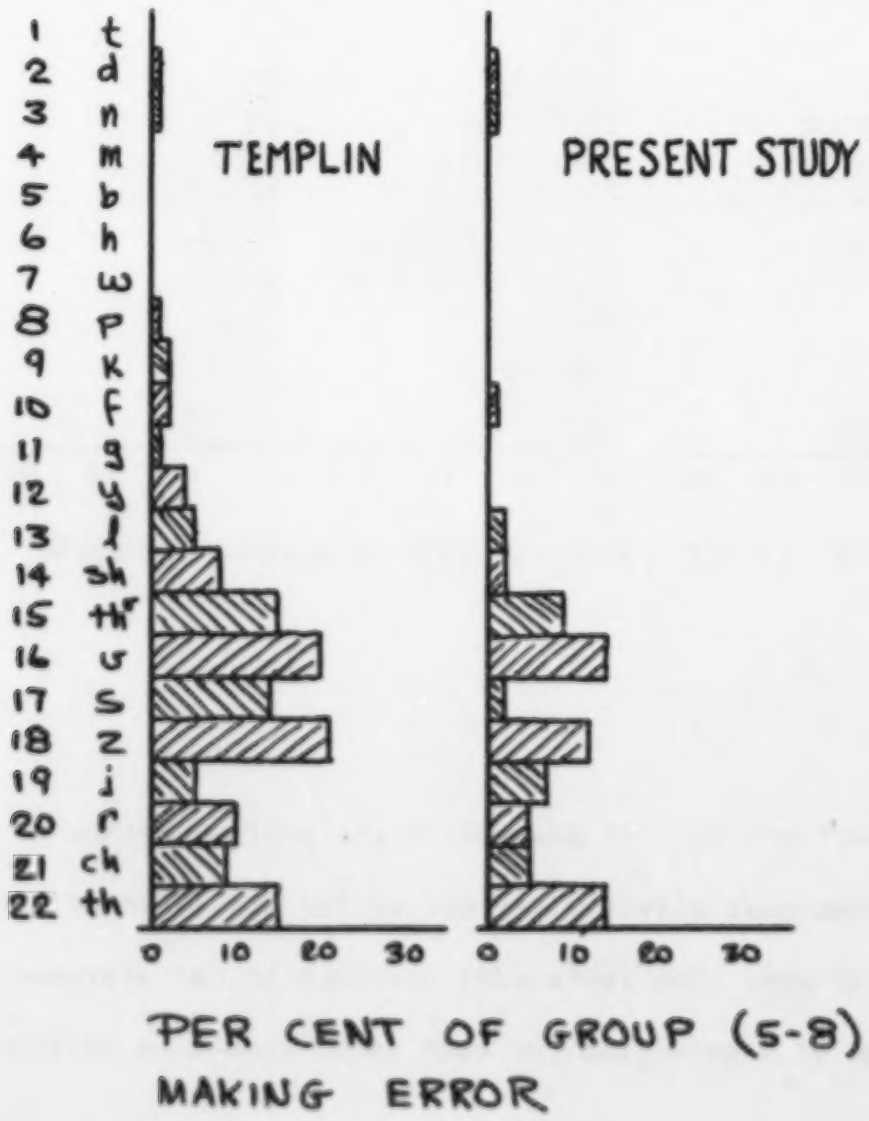
Templin's data as adapted to the profile method of presentation shows most directly the decreasing occurence of articulatory errors with age. The table adds credence to her statement that the exact age of acquisition for each sound cannot be determined while at the

same time confirming the general idea of the progressive ordering of sound acquisition. It should be noted in this regard that the sounds listed in categories 13 through 22 where most of the errors occur are not intended as a list of absolute order, but rather as a group of sounds, all of which fall into the category of those acquired latest by most children.

The very marked similarity between the two profiles presented in Diagram 7. adds confirmation to Templin's concept of the ordering of speech sound acquisition.

Diagram 7.

A Comparison of Templin's Data and the Data of the Present Study



Confirmation of the Templin ordering of sound acquisition permitted the present research to proceed with considerable confidence that the order of presentation determined for the stimuli and the construction of profiles based upon errors made by children to the stimuli could be used in a consideration of the developmental nature of speech sound accuracy.

e. The intelligence (Peabody I.Q.) of the normal population

One of the criteria for the inclusion of children within the normal control population was that their intelligence as measured by the Peabody Picture Vocabulary Test be no less than one year below the expected I.Q. for their age. Table 4. shows the distribution of Peabody I.Q.'s for the 160 children of the normal sample.

Table 4.

Distribution of Peabody I.Q.'s for the Normal Group

I.Q.	N
95- 99	14
100-104	11
105-109	19
110-114	31
115-119	26
120-124	18
125-129	17
130-	24
Total	160

$\bar{x} = 116.36$

s.d. = 12.7

$M_{IQ} = 116.36$

$SD_{IQ} = 12.7$

From the data seen on Table 4. the group appears to be highly homogeneous in verbal intelligence and in an acceptably normal distribution.

f. Auditory perception

Each subject in the normal population was given the Wepman Auditory Discrimination Test largely for the purpose of obtaining a

normal base for comparison with the auditory discrimination abilities of the experimental groups. Table 5. shows the distribution of scores on this test in the normal population.

Table 5.

Auditory Discrimination Scores
Obtained by the Normal Group

Age	Adequate AD	Inadequate AD	Legend for determination of adequacy of AD (after Wepman, 1959)
5	31	10	more than 6
6	34	6	more than 5
7	32	7	more than 4
8	32	8	more than 3
Total	129	31	

The data of Table 5. shows that within a normal speech population, 31 out of 160 children, or some 19%, show inadequate auditory discrimination. There appears to be a disproportionately high number of children in the 5 year old group showing inadequate auditory discrimination, some 25% when the cutting score used as an indication of inadequacy was that established in the original standardization of the test. This is in keeping, however, with the findings of other studies where it was found that children below the age of 5 years and 6 months were frequently unable to respond to the test with any degree of reliability.

B. Stage 2. Experimental Groups Studied.

As a test of the major hypothesis that articulatory profiles derived from children with differing etiologies would be identifiable one from the other as well as from the articulatory error profiles derived from a normal group of children, the following data is presented. In each case the profiles are shown as percentages of the total group studied in each category, followed by a table showing the actual substi-

tution errors. Additional data relating to a description of the group considered as having a developmental rather than a pathological etiology is also presented. Following the presentation of each separate etiologically based group, a comparison of the various profiles is shown.

1. Developmental group

a. Selection of population

As has been indicated, this group's identification and description was one of the major foci of the study. It was conceptualized that this group was in essence made up of normal children (without pathology) who demonstrated articulatory inaccuracy because of a lag in development of those processes necessary for accurate articulation, or stated otherwise, that they are children at the lower end of the normal distribution of accurate speech sound acquisition due to the slowness of the development of certain pre-linguistic factors which it is felt must develop before speech sound accuracy is acquired.

To obviate a geographical selection factor which might produce a source of difference between this population and the normal population discussed earlier, the children in this group were selected entirely from the same school population from which the normal population was drawn. To avoid the further problem of case selection from a larger population of children with suspected developmental articulatory inaccuracy, all of the children in the schools studied who met the criteria were included. (The N of the group was 47. N's of 30 were collected for the other experimental groups.)

All of the children in the Speech Therapy Classes of the Brookfield Public Schools between the ages of 5 and 9 who had previously been screened from the total school population and diagnosed as having a speech defect were tested. Five of the total of fifty-two

children were excluded from the study. Four because they carried a primary diagnosis of emotional immaturity and one because of a diagnosis of partial hearing loss. The remaining 47 children met the following criteria:

(1) Adequate intelligence (above I.Q. 90 on the Peabody Picture Vocabulary Test)

(2) Adequate visual and auditory acuity (as screened by the local school nurse)

(3) No known pathological or emotional problem to account for their articulatory inaccuracy as indicated on the school records including the medical history obtained by the school nurse and the school physician. (These were the identical criteria used in selecting the normal group.)

(4) A confirmed diagnosis of articulatory inaccuracy as determined by the school speech therapist and their consequent inclusion in classes for speech therapy.

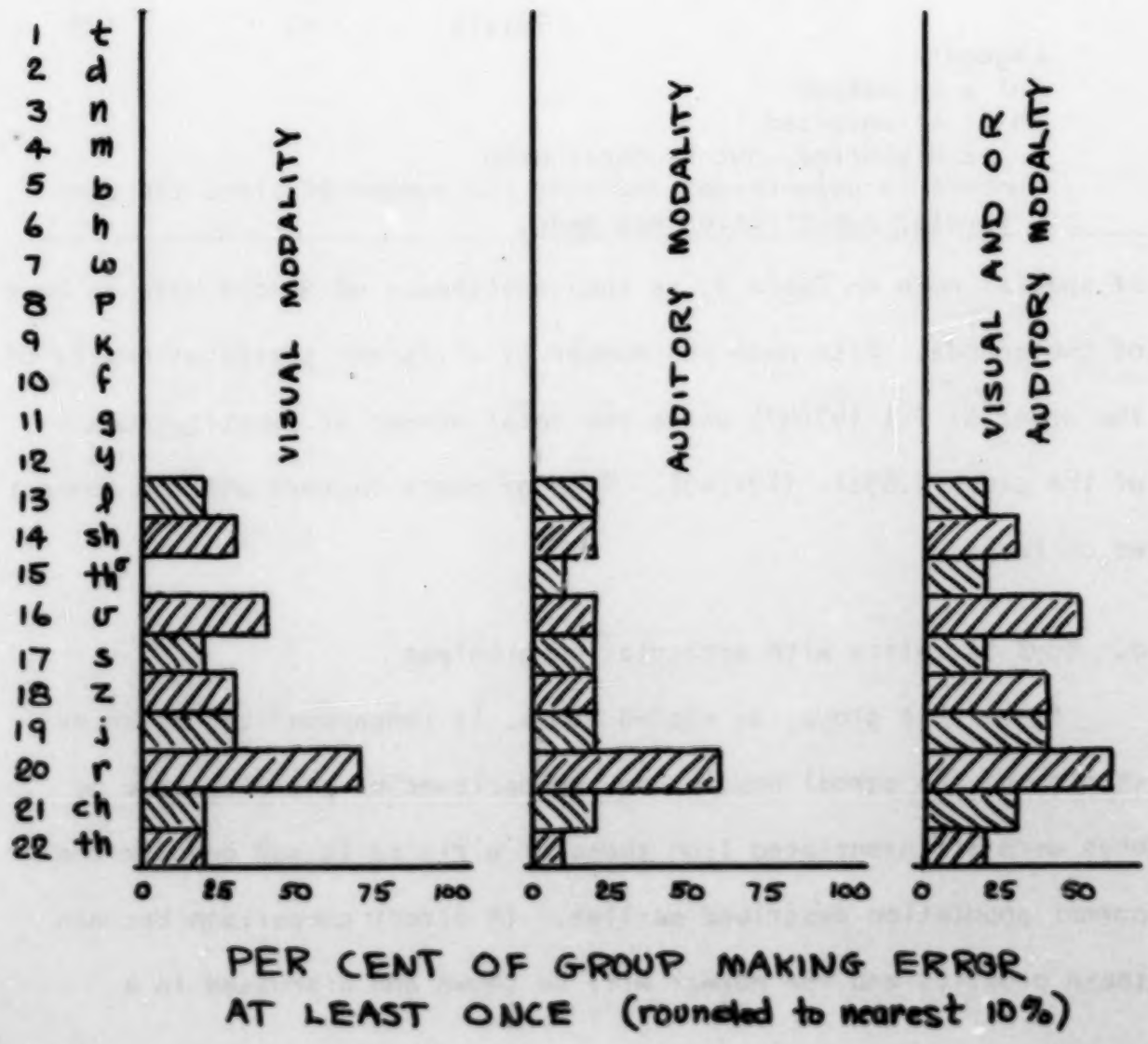
b. Percent of error profiles

Diagram 8. shows the articulatory error percentage profiles of the 47 children in reacting to the visual and auditory forms of the D.M.T.A. separately and collectively. As Diagram 8. indicates, there is a striking similarity between errors made to the two forms of the test. The profiles evidence errors in each of the sounds in categories 13 through 22; the predominance of errors of articulation on the 'r' (over 50% to both modalities) more than doubling the percentage of errors in any other single phoneme, underlines the importance of the phoneme in the language. Beyond the 'r', the 'v' phoneme seems more than any other sound to provide difficulty in the visual modality, but, rather surprisingly, not in the auditory. Perhaps of major importance to the concept being studied is the absoluteness of the cut-off above the 13th sound

category. Literally no errors were made by these children in the sounds included from category 1 through 12. While in general there appears by inspection to be a greater number of errors to the visual form when compared to the auditory form, statistically the difference is not significant at the .05 percent level of confidence. The numerical statement of the profile for this group of children then seems quite definite and clearly established. Errors which fall in the categories represented by categories 13 through 22 are characteristic of the child with a developmental lag.

Diagram 8.

Articulatory Error Profiles of the Developmental Group



c. Qualitative profiles

Table 6. shows the actual substitutions made by children in the developmental group.

Table 6.

Sound Substitutions Made by the Developmental Group (N = 47)

Sound order	Sound tested	Sounds substituted	# of Substit.	# times Substit.
13	l	w(8);y(4);r;n	4	14
14	sh	s(8);lateral(3);ch(2);th(2);ks	5	16
15	th'	d(3);b	2	4
16	v	b(21);th';?	3	23
17	s	th(4);ch(2);sh(2);lateral(2);hs	5	11
18	z	s(10);lateral(3);zh(2);d;l;th';ch;w;sz	9	21
19	j	d(10);zh(8);s;w;ch	5	21
20	r	w(30);y	2	31
21	ch	sh(10);th';s;t;ts;lateral	6	15
22	th	s(4);t(4);d(2);f(2);tw(2);sh	6	15
		Totals	47	171

Legend:
th' = th voiced
th = th unvoiced
? = distorted, not transcribable
Numbers in parentheses indicate the number of times the particular substitution was made.

Of special note on Table 7. is the consistency of errors made to most of the sounds. Also note the number of different substitutions is of the order of 1:1 (47:47) while the total number of substitutions is of the order 3.63:1 (171:47). Both of these factors will be commented on later.

d. Boys vs. girls with articulation problems

Since this group, as stated above, is conceptualized as an extension of the normal population, comparisons of profiles made by boys were differentiated from those of girls as it had been in the normal population described earlier. (A direct comparison between these profiles and the normal will be shown and discussed in a

later section.)

Diagram 9.

Comparison of Boys' and Girls' Articulatory Error Profiles in the Developmental Group

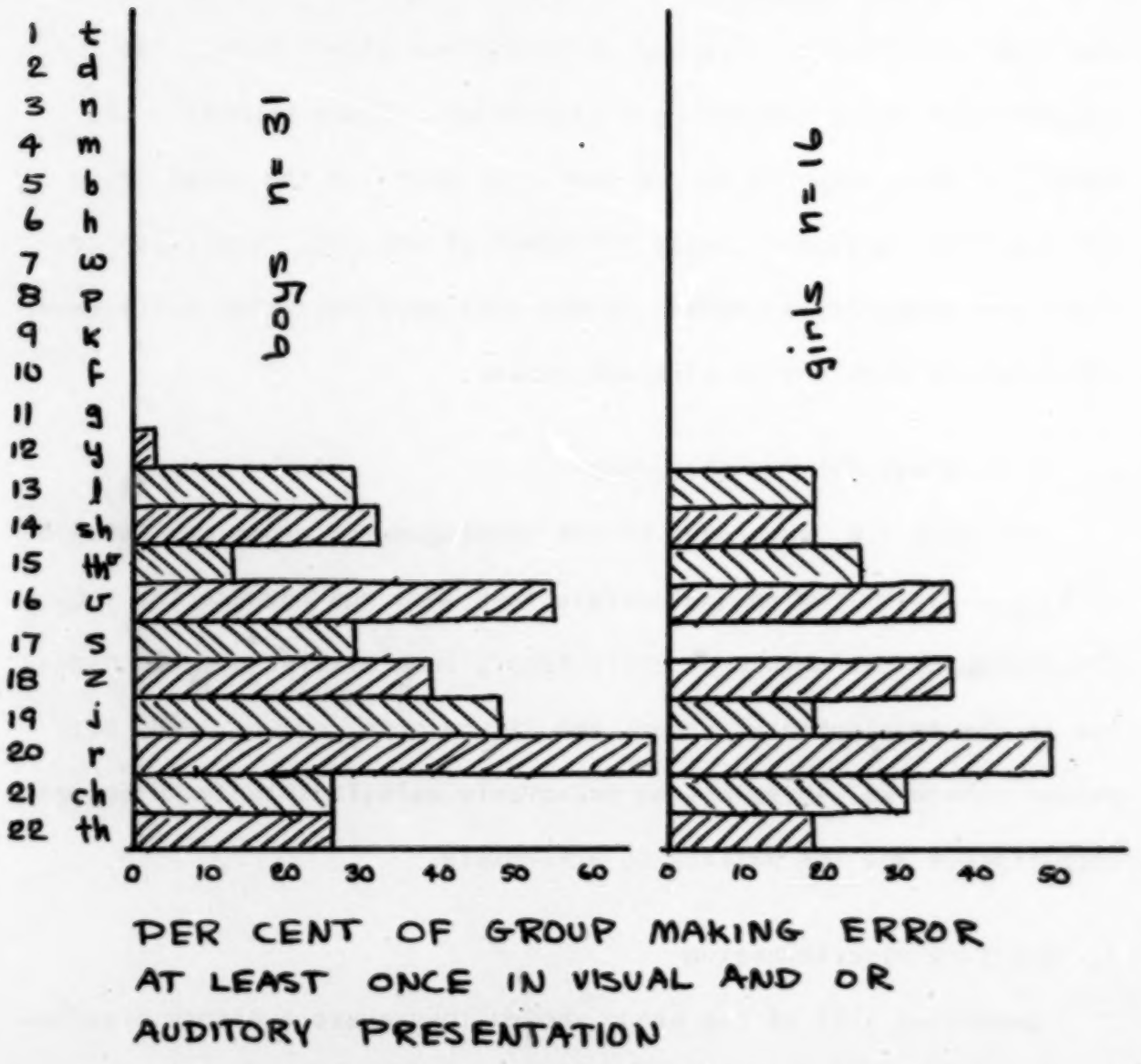


Diagram 9. brings out some most interesting sex differences. As indicated from the preceding total group profiles, all of the sounds in categories 13 through 22 are represented. The girls, however, show no errors in category 12 (the 'y' phoneme) as though they were, as a group, that much ahead of the boys in their maturation. In only two phonemes in which there are errors does the girls' percentage appear greater than the boys': (th voiced, 25% over 14%) and (ch, 31% over 25%). In every other phoneme showing an error, boys made more

errors and of course, percentage-wise, showed a higher percentage of errors ranging from a difference of 3% over 0% on the 'y' to a difference of 55% over 35% on the 'v'. Nevertheless, the difference between the total profiles of boys and girls was not significant. The diagram does bring out one very significant figure however - the number of boys compared to the number of girls in the total group (31 over 16) is significantly different at the .05% level, and confirms the generally accepted concept that more boys than girls have articulatory problems in this age range.

e. I. Q. (Peabody) for the group

The mean I.Q. (Peabody) of the developmental group was 110.978 ($S.D._{IQ}$ = 13.10). When the correlations were run between the I.Q. (Peabody) and the number of articulatory inaccuracies of the children in the developmental group, the figure obtained was -.05 or, stated otherwise, there was no measurable relationship found between intelligence and the ability to articulate.

f. Auditory discrimination

Seventeen (17) of the group showed inadequate auditory discrimination, while thirty (30) showed adequate discrimination ability. Stated percentage-wise for later comparisons, 36% had inadequate and 64% had adequate auditory discrimination. No significant relationships were found between severity of articulatory inaccuracy (number of sounds) and severity of auditory discrimination inadequacy. However, a correlation between articulation error severity and auditory discrimination scores for the total group approached the 5% level of confidence ($r = \pm .22$ with an $r = \pm .27$ being necessary.)

2. Experimental Group 2; Mentally Retarded

a. I.Q. level

Experimental Group 2 consisted of thirty children diagnosed by others as mentally retarded. The range of I.Q. as determined in the present study and the distribution of I.Q.'s in the group are shown in Table 7.

Table 7.

Distribution of Peabody I.Q.'s for the Mentally Retarded Group

I.Q.	N		
50/59	5		M_{IQ} = 70.83
60/69	7		
70/79	11		SD_{IQ} = 11.00
80/89	7		
50/85	30	Totals	C.A. range 5/9

b. Percent of error profiles

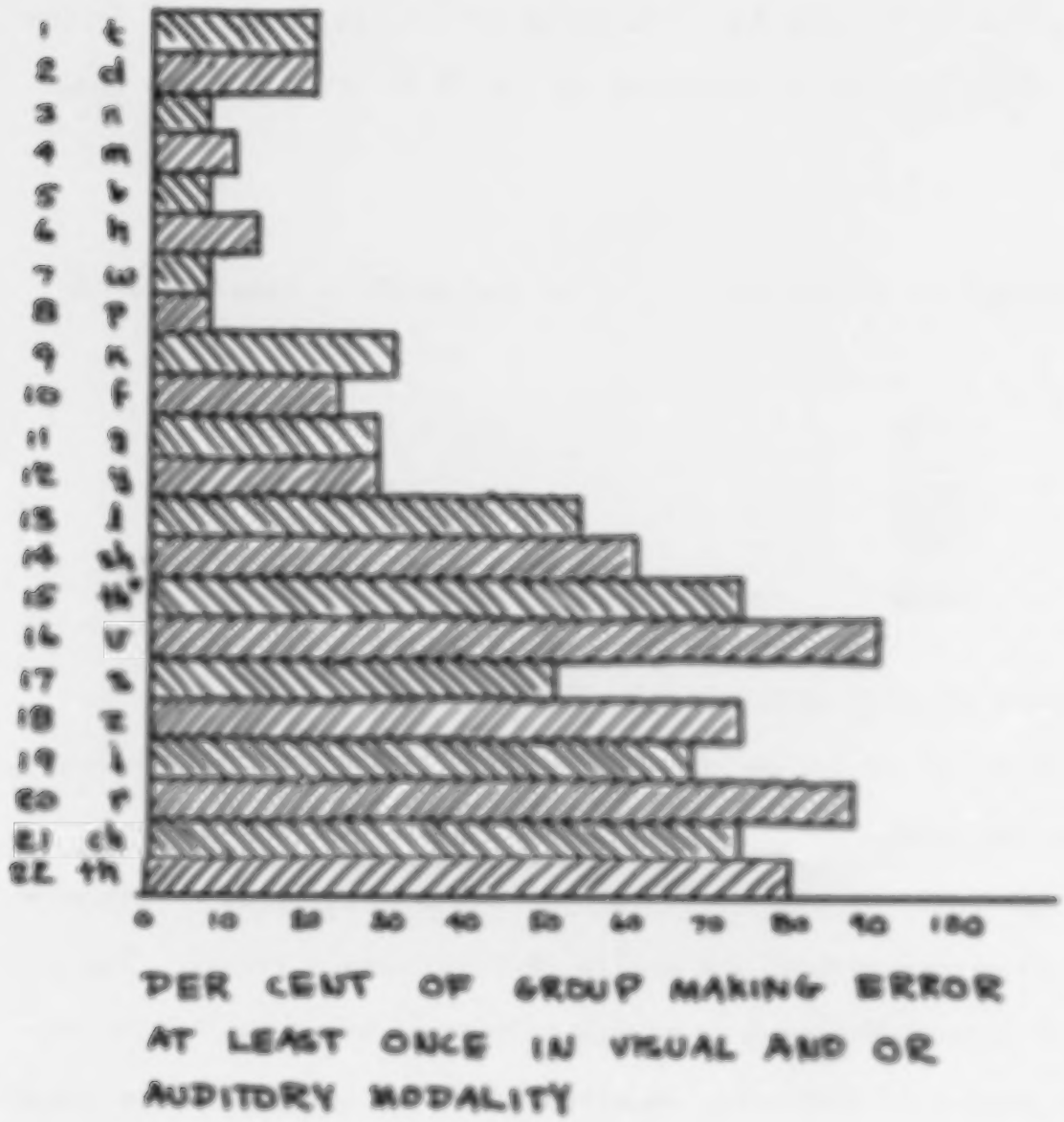
Diagram 10. shows the speech error profile for these 30 mentally retarded children.

Diagram 10. is notable for the evidence it provides of the wide spread of errors through the entire range of speech sounds. The progressive nature of speech sound acquisition is borne out by the increased amount of difficulty experienced in the group with the sounds said to be acquired last by all children. Note, for example, that over seventy percent of the children made errors on the last three sounds and that as in other profiles already shown, the 'r' is the single most difficult of sounds to acquire accurately.

Mentally retarded children in this age range have great difficulty naming pictures which are easily named by their more adequately endowed peers. For example, the picture used to elicit the 'v' sound

Diagram 10.

Articulatory Error Profiles of Mentally Retarded Group (N = 30)



(vegetables) was not within the naming vocabulary of over 80% of these children, while over 40% of the children misarticulated the 'v' in naming 'vacuum cleaner'. Considering the difficulty that children of inadequate intelligence have in naming pictures (better than 40% of the pictures could not be named), the profile of articulation errors must be considered as a minimal error profile since given the greater opportunity to err that other pictures would have provided, an even greater error score would be expected.

c. Qualitative profiles

Table 8. shows the actual substitution errors made by the children in the mentally retarded group.

Table 8.

Sound Substitutions Made by the Mentally Retarded Group N = 30

Sound order	Sound tested	Sounds substituted	# of Substit.	# times Substit.
1	t	k(2);g;d;tz;ts	5	6
2	d	g(3);t(2);ch;ds	4	7
3	n	m	1	1
4	m	n;p;omit	3	3
5	b	d;v	2	2
6	h	omit(2);n	2	3
7	w	d;v;?	3	3
8	p	b;?	2	2
9	k	t(6);p(2);g;m;h;omit	6	12
10	f	g;p;w;s	4	4
11	g	d(6);k;?	3	8
12	y	d(3);omit(3);w(2);?(2);t;j	6	12
13	l	w(11);y(7);n(2);omit(2);d;k;sw	7	25
14	sh	s(9);?(3);k;g;d;ch;h;w;f;tch	10	20
15	th'	d(8);v(3);b(3);g;t;omit	6	17
16	v	b(20);k;d;n;p;w;f;omit	8	27
17	s	th(3);ts(3);t(2);sh(2);?(2); tz; k;g;d;ch;h	11	18
18	z	[illegible] st;?;omit	11	23
19	j	d(14);zh(4);g;?;omit	5	21
20	r	w(23);omit	2	25
21	ch	t(11);sh(5);ts(2);tz(2);omit(2); g;h;s;?	9	26
22	th	f(14);t(12);s(2);d(2);ts;g;p;w; sh	9	35
		Totals	119	300

Legend:
th' : th voiced
th : th unvoiced
? : distorted, not transcribable
omit : sound tested omitted, remainder of word spoken
Numbers in parentheses indicate the number of times the particular substitution was made.

The widespread nature of the articulatory inaccuracies of the mentally retarded are amply demonstrated on both the quantitative

Diagram 10. and the qualitative listing of errors on Table 8. Of special interest is the piling up of substitutions in the last 10 sounds and the spread or inconsistency of substitutions. While it is notable that a majority of these children substitute the same sounds that others do, certain sound substitutions seem characteristic of this group alone - note 'f' as a substitute for 'th'; 'k' and 'g' as substitutes for 't' and 'd' respectively, and the reverse 't' and 'd' substituting for 'k' and 'g'. Error substitutions of this type are rarely seen in other etiological groups.

The number of different substitutions is an interesting expression of the widespread inconsistency found in the articulation of the mentally retarded. Note, 119 different substitutions were made (with an N = 30, almost 4 different substitutions per child) while the actual number of all substitutions for this group is seen as 300 (or 10 substitutions per child).

4. Auditory Discrimination

Only three of the thirty children in the group were able to comprehend the instructions for the auditory discrimination test. The others were all invalid protocols.

3. Experimental Group 3; Cleft or Short Palate N = 30

As an illustration of a pathological etiology underlying an articulatory inaccuracy pattern this group of children, all of whom were born with either a cleft palate or a congenitally short palate were selected. In this instance, the articulatory errors can be ascribed to a failure to close off the nasopharynx and a consequent inadequate oral air stream. The articulatory patterns shown are those appearing in addition to the

hypernasality.

a. Percent of error profiles

Diagram II. shows the articulatory error profiles for the children in this group.

Diagram II.

Articulatory Error Profiles of Cleft or Short Palate Group (N = 30)

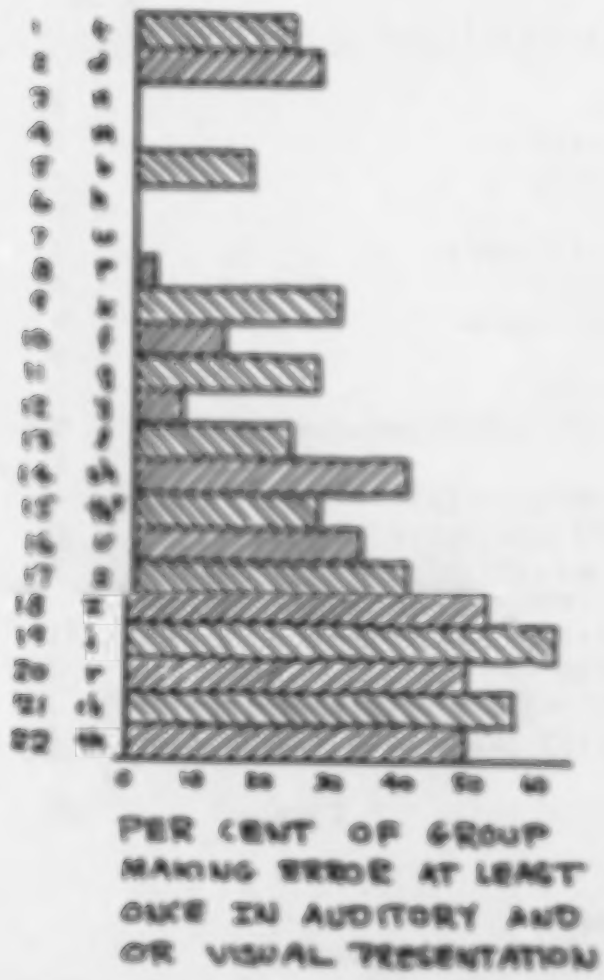


Diagram II. shows the over-all breadth of inaccuracy of articulation made by these children. Notably, there are no errors seen in response to the 'm' and 'n' sounds, nor to the 'h' or 'w' sounds. As in every profile there is a massing of errors on those sounds acquired last, but the addition of errors on the plosives and frica-

tives above the last ten indicate the pervasiveness of the articulatory problem.

b. Qualitative errors profile

Table 9. shows the actual substitutions made by the children in the cleft or short palate group.

Table 9.

Sound Substitutions Made by Cleft or Short Palate Group N= 30

Sound order	Sound tested	Sounds substituted	# of Substit.	# times Substit.
1	t	k(4);h	2	5
2	d	g(3);n(2)	2	5
3	b	m(2);p(2)	2	4
4	p	omit	1	1
5	k	h(3);t(2);omit	3	6
6	f	k;m;t;y;d	5	5
7	g	y(2);k;h;omit	4	5
8	y	n;w	2	2
9	l	w(3);y(2)	2	5
10	sh	s(3);t(2);th(2);wh;m;n;k;omit;?	9	13
11	th'	?	1	1
12	v	b(4);th(2);w(2);f	4	9
13	s	omit(4);k;n;m;t;f;th;lateral;?	9	12
14	z	s(5);omit(3);n(2);d(2);tha(2);k;?	7	16
15	j	zh(9);d(6);y(2);g;m;s;da;ch;omit; lateral	10	24
18	r	w(14);n	2	16
21	ch	sh(11);t(2);k;m;y;tsh;ts; omit(2)	8	20
22	th	t(9);f(7);k(3);d(2);s(2);tsh;w;h	8	26
		Totals	81	175

Legend:
th' = th voiced
th = th unvoiced
? = distorted, not transcribable
omit = sound tested omitted, rest of word spoken
lateral = lateral emission
Numbers in parentheses indicate the number of times the particular substitution was made.

Here on Table 9. it should be noted that the substitution patterns are peculiar to the type of child being considered, the cleft or short palate child. While some of the common substitutions are

made, substitutions unlike any of the other pathological or developmental groups appear due to the nature of the defect. More omissions occur and many more laterally emitted sounds.

It is also worthy of comment that the number of different substitutions is 81/30 or 2.7 per child, while the number of total substitutions is 175/30 or 5.8 per child.

c. I.Q. distribution

The mean I.Q. (Peabody) for the cleft and short palate group was 105.56 (sd = 13.25). The children as a group then appear to be adequately intelligent and the distribution seems to be adequately normal.

d. Auditory discrimination

As a group these children showed more inadequate auditory discrimination scores than any of the other groups tested. 19 had inadequate scores, 8 were adequate and 3 tests were invalid.

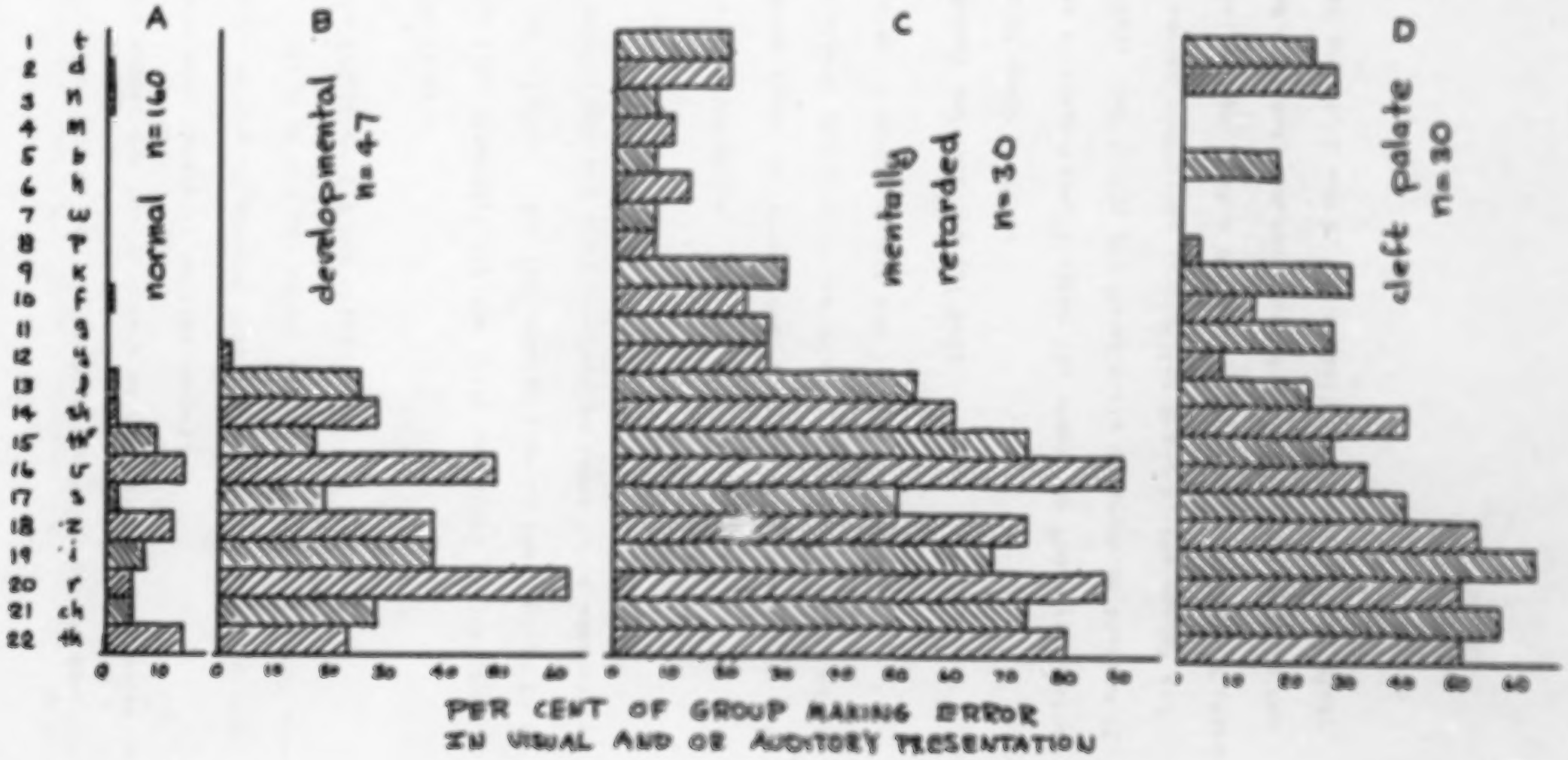
4. Combined Normal and Experimental Data

a. Percent of error profiles

For ease of comparison, Diagram 12. shows the four articulatory error profiles. Two things are immediately apparent on Diagram 12. First, the marked similarity in profiles A and B, the normal and developmental groups, with a difference only in the number of children involved. Second, the very marked difference between the two pathological groups, C and D, the mentally retarded and the cleft

Diagram 12.

Comparison of Articulatory Error Profiles for All Groups



palate groups, when their profiles are compared with the developmental group. These differences are both in the diversity of the error pattern and in the amount of error made. This latter point is most dramatically seen in Table 10. below.

Table 10.

Comparison of Number of Different Errors and Total Number of Errors Made by the Four Groups

Group	N	# of Different errors	Total # of errors
Normal	160	30	122
Developmental	47	47	171
M.R.	30	119	300
C.P.	30	81	175

A normal population which has been screened for what are commonly called speech defects will still show a few articulatory inaccuracy patterns, but they will average less than one per child. A group slow in developing the articulatory accuracy expected of them, those diagnosed by a speech therapist as needing therapy, will show many more substitutions, but if no pathology exists, the pattern of their articulatory inaccuracy will be almost identical to the normal population.

From this data both on the profiles of Diagram 12 and Table 10., such children will show about one different substitution per child, and approximately 3.6 errors per child. Mentally retarded children show a wide spread of articulatory inaccuracy affecting literally every sound in the spectrum as Profile C shows, and as Table 12. indicates the children make some four different errors per child, while making some ten errors per child over-all. While the error profiles for the cleft palate children appear not dissimilar from

that of the mentally defective children certain notable differences do exist. Quantitatively, the cleft palate children are more consistent in their substitution patterns - note, a ratio of 81/30 or some 2.65 different errors per child, while the total number of errors approaches 6 per child. Also, notably, the cleft palate child, unlike the mentally retarded, shows no errors on 'm', 'n', 'h' or 'w', while the mentally retarded show some difficulty with all of these.

b. I.Q. Distributions

Table 11. shows the distribution of I.Q. Mean Scores and Standard Deviations of the mean for the four groups.

Table 11.

Distribution of I.Q.'s for the Four Groups

Group	Mean IQ	S.D. IQ	N
Normal	116.36	12.71	160
Developmental	111.00	13.02	47
Mentally Retarded	70.833	11.00	30
Cleft Palate	105.566	13.25	30

As the table indicates, each group is relatively homogeneous. Children without (or relatively without) articulatory inaccuracy seem to do better on the verbal test of intelligence used in the study. There is a significant (.05% level) difference between each of the groups studied in the I.Q. measurement used. However, the relationship of articulation to intelligence based on the percentage of children making errors is significant only for the mentally retarded group.

c. Auditory discrimination

Complete auditory discrimination comparisons were available only for two of the groups. Table 12. shows the number of children in

each group making errors on the test.

Table 12.

Comparison of Normal and Developmental Groups
on the Auditory Discrimination Test

NORMALS			DEVELOPMENTALS		
Age	Adequate AD	Inadequate AD	Adequate AD	Inadequate AD	*
5	31	10	7	4	(6)
6	34	6	11	7	(5)
7	32	7	10	5	(4)
8	32	8	2	1	(3)
Totals	129	31	30	17	

(* Number of errors for inadequate AD)

It is very evident by inspection that the children in the developmental group have more difficulty in auditory discrimination than do the normals studied. Statistically the difference is significant at the .01% level. Expressed as a percentage, 31/160 or 19% of the normals showed inadequate auditory discrimination, while 17/47 or 36% of the developmental group showed auditory perceptual difficulty. While no age breakdown was collected for the cleft palate group, of the 30 children, 19 showed inadequate scores - or 19/30 - 63%. This is by far the largest percentage of children the writer has seen with poor auditory discrimination. A further check of mild hearing loss should be done with this group before the discrimination figures are accepted at face value. One of the characteristics of the cleft palate child is a mild and frequently overlooked hearing loss. (Wepman, J.M., and Gaines, Frances P., 1949)

IV. DISCUSSION OF RESULTS

Much of the evidence for the test of the major hypothesis is evident by inspection of the articulatory profiles. As shown in the study of the normal population:

1) There is a notable decrease in the number of articulatory errors made from year to year;

2) The errors that are made fall almost exclusively in the categories from 13 through 22, those sounds which other studies have consistently held to be acquired last by all children;

3) By the beginning of the ninth year, the number of recognizeable errors made are so few as to be almost non-existent.

When boys are compared with girls two factors appear:

1) No significant difference is found in either the number of children showing errors or in the

2) error pattern.

However, it should be noted here that this 'normal' group had previously been screened for speech defects of all types. As was seen later, a fairly marked difference does appear between the sexes in the children said to have a speech defect.

A comparison of the sound error profiles of the normal group of children (N = 160) with constructed profiles for the children of the same ages reported by Templin (1957) confirmed her findings of the essential ordering of sound acquisition. Her groups showed a greater error score than did the children of the present study. It should be remembered in this regard, that her groups were not screened for speech defects which would increase the number of errors found. Also, the method of assessment was not the same - she used spontaneous speech, while in the present study only stimulus-response error profiles were determined.

The similarity of the findings permits the conclusion that sounds are acquired in a particular sequence and the the order which she (Templin, 1957) presents is a useful one for consideration of a profile alignment such as the one used in the present study.

The qualitative data show several points of special interest to speech therapists and to teachers. For the normal and developmental groups, the actual substitutions made are remarkably similar. Thus, the sound attempted literally predicts the sound substitution. The essential difference between these two groups lies then, not in the error pattern, but in the number of such errors made.

The qualitative analysis of the actual substitutions made shows some rather striking similarities between all four groups, in that the greatest difficulty is experienced with the sounds said to be acquired last. Typical substitutions are seen in the normal and developmental groups, especially. Note, for example, the substitutions to the last ten categories. Here, as would be expected, considering the progressive nature of sound acquisition theory, the greatest number are seen.

V. RECAPITULATION AND SUMMARY

A. Purpose

The essential aim of the research was to identify the articulatory inaccuracy profiles of children according to the etiology of the condition producing their difficulty in speech. It was held that such profiles would be so different one from the other and from the articulatory profiles of unimpaired speakers of the same age that it would be possible to predict the etiology from the speech pattern and vice versa that it would be possible to predict the speech pattern from the etiology. The value of such a study it was held would lie essentially in the advantage

that would accrue directly to school systems in knowing which of their children in the early school years who showed some speech inaccuracy did so because of some pathological reason such as cleft palate, emotional immaturity, mental retardation et cetera in which case they should have early and persistent therapy, or whether the noted inaccurate speech production was simply a developmental problem which would in all likelihood be self-correcting. A secondary value, of course, would lie in the proper classification of children with speech inaccuracy leading to proper labelling and consideration of them. Again, by identifying those children whose problems were due to maturation rather than to pathology, society, both at school and at home, could avoid all of the problems inherent in fixing the label 'speech defective' with all that label implies on such children.

B. Methodology

To accomplish the purposes set forth the research was designed in two phases. First, to prepare an instrument or battery of tests which would provide reliable and useful information on the articulatory patterns of children, the verbal intelligence of the children and their auditory perception. Since this necessitated the development of a new test for articulation it also required the standardization of the test. By following this procedure the research obtained a control group of non-speech-impaired children to use in comparison with the known speech impaired groups. Phase one, then, consisted of the development of a new test for articulation following the concepts of the investigator that proper testing of speech production would need to explore responses to both auditory and visual stimuli. This test consisting of 42 pictures and 44 words was pre-tested on a normal population of forty children, half males and

half females, at each of the four age levels of immediate interest, five through eight. To ensure reasonably homogeneous backgrounds for the population they were all selected from a single school system in a suburb near Chicago (Brookfield, Illinois). Each child had previously been screened for visual and auditory acuity as well as for speech adequacy. They were further screened during the research for intelligence by use of the Peabody Picture Vocabulary Scale. To be accepted into the research population they needed to have a Peabody I.Q. of over 90. The 160 children of this normal sample were given the three tests of the battery, the articulation test, the vocabulary scale and Auditory Discrimination Test.

The articulatory error profiles derived for each age level showed the following: (1) that even in a screened normal population such as this certain sounds will be misarticulated; (2) that the sounds that are inaccurately produced will all be within the last ten consonants acquired by all children according to the studies made of large scale normal populations by Templin (1957); (3) that the substitute sounds made by these children would all or almost all be typical substitutes for the sounds intended (thus, 't' for 'th', 'b' for 'v', etc.); (4) that boys and girls would show the same profile of errors; (5) that within the normal population there would be a marked decrease in the number of substitutions and in the sounds affected with increasing age.

The Peabody I.Q. derived for the group was well above normal expectancy $\bar{X} = 116.36$ $(sd = 12.7)$.

Of the 160 children 31 showed inadequate auditory dicrimination scores. This is in keeping with other studies which have shown that approximately 20% of all children at these ages have inadequate development of auditory perception whether or not they have articulatory speech prob-

lems.

The second phase of the research was devoted to a study of the articulatory errors of three experimental groups. The first of these were 47 children who had been previously screened by the speech therapist at the same schools which had provided the normal sample and had been accepted in speech therapy as having articulatory problems needing correction despite the fact that they (1) had no visual or auditory acuity problems, (2) no intellectual problems, and (3) no known pathology to account for their inaccurate articulation. The odd number of this group (47) was due to the fact that all of the children in the age group of interest (5 through 8) who met the criteria were included. This avoided the problem of selection. The same school system was used to reduce the sociological effect of geographical location, over-all family status et cetera. Each of the children were given the three test battery.

The articulatory error profiles for these children revealed the following: (1) the errors made by the children were all in the last ten sounds on the acquisition of speech sound lists prepared by Templin (1957) and confirmed in the normal population studied in the present research. These are the same sounds in which the normal sample showed its substitutions. (2) The errors made qualitatively showed the same pattern of substitutions shown by the normals (thus, 't' for 'th', 'b' for 'v' et cetera). (3) The only way the profiles of these children differed from the normal population was in the number of children making errors on more of the sounds. A reasonable conclusion from this data seems to be that this group of children who show no pathology to account for their articulatory inaccuracy do not in fact have a speech defect, but are delayed in acquiring the accuracy of production expected of them probably due to lags in development of those pre-speech conditions necessary for accurate production. Most importantly it would be expected from the

limited pattern of their inaccurate speech that as they became more adequate in auditory perception and other developmental factors they would correct their own substitutions in speech.

Since this group was a part of the school population from which the normal population was taken a scrutiny was made of the profiles of articulation for the two sexes. Here the profiles were identical, but the number of boys was almost exactly twice the number of girls. (31:16). This is in keeping with the widely held opinion that more boys than girls enter school with articulatory problems and that boys tend to be slower in developing some of the fine skills that girls have already developed at this age.

Finally, a study of the articulatory profiles of these children showed the now expected pattern of marked decrease in the number of sounds affected and the number of children making substitutions with age.

The Peabody I.Q. mean for the group was 110.978 (sd = 13.10). While this is still well within the normal limits it is notable that there is a significant difference between the mean of this group and the normal group. However, correlations run between articulation errors and I.Q. showed a -.05 relationship.

The auditory discrimination pattern of this developmental group showed that 17 of the 47 had inadequate auditory discrimination scores. This is a significantly greater number than found in the normal population and undoubtedly accounts in part for the delayed development of adequate articulation. It was apparent, however, that auditory discrimination did not account for all of the difference found. Studying the profile of sounds in which errors occur it is found that two of these are the very common substitution of 'w' for 'r', and 'y' for 'l'. Both of these substitutions have been demonstrated by others as related to lags

in motoric coordination. While no evidence relating to this was sought in the present research, the finding seems worth reporting.

The second experimental group studied was the mentally retarded. These were thirty children in special classrooms for the Educable Mentally Handicapped in the Chicago Public Schools and in the Hammond, Indiana Public Schools. The Peabody I.Q. mean for this group was 70.83 (sd = 11.00). The range of I.Q. was between 55 and 85. The distribution was acceptably normal. The articulatory profile derived for this group was characterized by the following patterns: (1) errors occurred in every consonant of the language; (2) the number of different errors made in response to each stimulus averaged 4 per child or 119/30; (for the normal population this average was 30/160 and for the developmental group it was 47/47); (3) the greatest number of errors tended to appear in the sounds acquired last by all children; (4) not only were the number of different substitutions greater as indicated, but the actual number of errors per child were markedly greater. In this group the average error per child was 10 (300/30) while in the normal the comparable figure was 122/160 and the developmental group's was 171/47.

Only three of the thirty children were able to obtain valid scores on the auditory discrimination test. The test was not deemed useful then for the mentally retarded child, without at least some complete alteration of administration technique.

The third experimental group were thirty children all of whom had been diagnosed as having an operated cleft palate or a congenitally short palate. This structurally different group is noted for having articulation problems. The articulatory error profiles for them demonstrated this expectancy. (1) They showed a wide spread of errors affecting every sound tested except the 'm', 'n', 'h', and 'w'; (2) they showed qualitatively a different pattern than did the other groups in that their sub-

stitutions were in the nature of omissions more than altered or substituted sounds; (3) they had the expected hypernasality affecting all of their speech; (4) like every other group they showed the greatest number of errors in the sounds said to be acquired last by all children.

The Peabody I.Q. of this group showed a mean = 105.566 (sd = 13.85). While this was still within the normal limits and the group relatively homogeneous intellectually, nevertheless there was a significant difference between their mean I.Q. and the other groups, both retarded and normal in intelligence.

The auditory discrimination assessment of this group also showed the greatest number of inadequate scores, 19 of the 30 showing above the cut-off points for their age. This may account in part for their increased articulatory errors although the number should be interpreted with some caution. Cleft and short palate children are notable for showing mild hearing loss as a complication of their physical anomalies. While this group was screened for auditory acuity, no complete audiological evaluations were made. It may well be that such children would be found to be quite adequate in audition on a screening test and still show mild aural deficiencies.

C. Conclusions

The research demonstrated that the articulatory profiles derived for children with different etiologies are each different from the other and readily identifiable as the profile characteristic of the etiology of the disorder in question. Further studies should be made to identify other pathological profiles of articulation. The group considered as suffering from developmental lags were found to have

articulatory error profiles identical with the normal population, leading to the conclusion that they are in fact part of that population and not children with speech defects. This fact leads to the question of therapy for such children which should be explored in some rigorous fashion. It is the considered opinion of the present research team that such children will do equally well with or without therapy, but this needs to be demonstrated.

APPENDIX

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DUAL MODALITY TEST OF ARTICULATION

NAME_____ SEX_____ TEST DATE (yr.)_____ (mo.)_____ (day)_____

SCHOOL OR INSTITUTION_____ BIRTH DATE_____

GRADE_____ CLINIC #_____ C.A._____

VISUAL MODALITY

No.	SOUND	STIMULUS	RESP.	STIMULUS	RESP.
22	t	t.v.		table	
21	d	door		dog	
20	n	knife		nose*	
19	m	moon		monkey	
18	b	baby		bed	
17	h	house		hammer	
16	w	wagon		window	
15	p	pencil		pig	
14	k	car		cat	
13	f	fork		foot	
12	g	gun		gas*	
11	y	yo-yo		yard*	
10	l	leaf		lamp	
9	sh	shoe		shadow*	
8	th'	----		----	
7	v	vacuum		vegetable*	
6	s	sun		scissors	
5	z	zipper		zebra	
4	j	giraffe*		jump*	
3	r	radio		rain*	
2	ch	chain		chair	
1	th	thumb*		three*	

AUDITORY MODALITY

STIMULUS	RESP.	STIMULUS	RESP.
time		took	
day		done	
need		new	
my		most	
big		but	
how		him	
wail		wish	
pay		pass	
cut		call	
for		fine	
good		get	
yet		you	
low		look	
should		show	
that		then	
very		visit	
same		seen	
zinc		zone	
just		job	
ride		race	
chase		choose	
think		thank	

PEABODY M.A._____

I.Q._____

AUD. DIS._____/30 _____/10

Artic. Scores:

VISUAL:_____

AUDITORY:_____

TOTAL:_____

Vision_____

Hearing_____

Add. Info:_____
(speech training?, etc.)_____

DIAGNOSTIC CATEGORY:

_____

* consult back of stimulus card